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Impact of shocks oil prices on the stock market

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Abstract

This research investigatesthe reactionof Saudi Arabia stock market to changes in the prices of crude oil. Considering the non-linear relationship in the stock market to determine the asymmetric response in the result of positive and negative changes in crude oil by applying NARDL model.The study utilizes crude oil weekly price (the OPEC crude Basket price), and Saudi stock index TASI expressed in the US dollar, in weekly period basisstarting at January 1995 until December 2018. The empirical analysis outcomes show that the Saudi Arabia stock market (index TASI) is affected by the shock's crude oil pricein the long-term. Also, the Saudi Arabia stock market and shocks crude oil price show asymmetric cointegration. The research is significant for the Government of Saudi Arabia, as an OPEC policy maker, where fluctuations in crude oil prices affect its overall economy and financial markets. In addition to researchers, regulators and participants in the Saudi stock market will find this research useful in order to predict the movement of shares and the expected returns from them.

Keywords: *Saudi Arabia Stock Market, Crude oil prices, a nonlinear ARDL model, asymmetric cointegration analysis*

I. Introduction

Thechanges in the prices of crude oil play a key role in examining the stock price volatility at times, butamong economists, no unanimity exists on the association between the oil and stock prices. Basher et al. (2018); Ono (2011), for instance, suggested that in Brazil and Mexico the stock market returns are not influence by the changes in the oil prices. Jones and Kaul, (1996); Effiong, (2014); for instance, found a settled negative associationbetween stock market returns and changes in oil prices.

The oil price significantlyinfluences the stock returns in oil-importing countries, except in the U.S. case (Joon and Park 2017; Wei and Guo 2017). High energy costs influence driving production costs and CPI costs. However, financial market prices indirectly affected current account imbalance and reduced the growth of the oil-importing economies.

On the other hand, Bjarmaland (2009) reported the oil-exporting economies to respond to rising oil prices by increasing wealth and aggregate demand. This occurs due to the monetary policy shocks which pose as a driving force behind the instability of stock prices in a brief interval. When the US dollar value increases, the

balance of the current account, government revenue and GDP will also increase. As a result of this, oil prices hurt economies that are importing oil and a positive effect on the economies of countries selling oil.

1.1 Background of the study

Oil as a product plays a dominant role in moving the economy globally. Saudi Arabia is one of the greatest contributors in the universal oil market it produces more thana tenth of the world's oil production and owns around 18 per cent of the world's proven reserves. This makes it the second largest OPEC Member Country, usually playing a focal part in OPEC's decision-making (see Organization of the Petroleum Exporting Countries 2019).

In the mid-1980s, created a worldwide oil glut, and demand initiate to fall due to recessions in the economic performance of industrialized countries, which affected oil prices to lose more than half their value in five years. The production of the Kingdom (which played the role of the most likely producer in the market at the time) fell from oil to about 2 million barrels a day. OPEC production fell from 30 million barrels to about 17 million barrels a day to maintain oil prices at high levels. This reduction in production from OPEC did not curb the decline in oil prices (Moschino 2003). During this period, the state has helped its fiscal surpluses from previous years, easing the fall in prices.

1.2 The problem statements

Fluctuations in oil markets in recent years have affected the Saudi stock market, which was recently established in the 1985 and beyond. It has led to increased interest in development, especially after the second oil boom in 1979 until the end of the year. The importance of the research is determined from the key point that there is an association between fluctuation of the oil markets and Saudi stock market because oil represents a basic resource in the Kingdom's income, and the depth of the required in the theory and guidance in the analysis and touching it in real reality.

1.2.1 Objectives of the Studies

Investigating the impact of shocks crude oil price on Saudi Arabia stock markets is interesting for sundry reasons. Firstly, it is the highest crude oil exporter in the globeand has the second-largest reserves of oil, which accounts for nearly 90% of exports, therefore, the stock market is probably liable to changes in crude oil price. Secondly, Saudi Arabia market differs from other developed and emerging countries in that, it is a part of international markets and is overly sensitive to provincial political events.

1.2.2 Research Questions

The study's research questions are

1- Do the fluctuations in crude oil prices impact on the Saudi stock market?

2- Is it possible for the stock market to withstand the firm against crude oil price shocks?

1.3 The Scope of the Study

The study includes a series of Saudi Arabia stock market index and OPEC crude oil price within the weekly period starting from January 1995 through December 2018. At first years of the Saudi stock market depends greatly on the index of it on a small sample of companies whichwas doubled in recent years. The study

included two parts, the first part (the theoretical framework), the theory of economic fluctuations and the theoretical relationship between financial markets and oil markets. The second part entails statistical estimates and economic analysis which influence the volatility of oil markets and the stock market.

1.4 The Relevant of the Study

1.4.1 Importance

The importance of the research is illustrated by analyzing the association and linkamong shocks crude oil price and their impact on the performance of the stock market. The Saudi economy relies heavily on oil revenues, and the volatility of markets reflects from time to time the returns of companies that use some in the financial markets.

However, we note that most of the studies on the financial markets effect and volatility of oil markets were limited to macroeconomic factors and it doesn't address the oil markets. Also, it doesn't consider oil price volatilities as one of the macroeconomic factors and measures their impact on stock markets, especially in the crude oil exporting countries.

Therefore, studying the effecton returns of Saudi Arabia stock market by shocks of crude oil price helps investors to do substantial decisions about investment and may be useful to stock market policymakers. Due to these factors, we should be proving its impact hypothesis and investigating it by analyzing the association among the crude oil prices and Saudi stock market that will help in verifying the ability of the stock market to withstand the changes in crude oil prices.

1.4.2 Usefulness of study

In this research, we will focus more on the impact of shocks of crude oil price on the instability of the Saudi Arabia stock market during the weekly period from 1995 to 2018. We investigate whether these shocks are positive or negative and whether the degree of correlation is affected by the increase or reduction in crude oil price thatcontribute to the instability of the and the expansion of the Saudi economy.

II. Literature Review

2.1 Global Studies

Many research works were carried out on the impact of stock prices conceive of oil price shocks through the use of different econometric instruments with regard to several exporting as well as importing countries of oil. It is believed that oil prices impact the stock market and macroeconomic variables based on regression analysis. Jones and Kaul (1996) highlighted important changes in the returns of stock market due to the shocks of oil price in the developed countries such as UK, Japan, Canada and US, where change in oil prices cast direct and indirect negative impacts over stock market efficacy through the effect of such changes on cash flows during the post-war period.

Furthermore, research focused specifically on the stock markets of USA which shows positive changes in oil prices tend along with growing impact on equity returns. Kang et al. (2016) indicate that real stock returns conceives positive effect of shock in U.S. oil supply, this differs from a non-U.S. oil supply shock. Although

negative shocks in the supply of oil in the U.S have negative effects on the portfolio returns of automotive and retail revenues, however, it has a significant impact on the metal sector. Through cover, the first period is examining in Kilian and Park (2009) from January 1973 to December 2006, and the second the oil production expansion in the U.S. from January 1973 to December 2014. By applying a Vector Autoregressive (VAR) model.

2.2 GCC Countries Studies

Aroura and Fuqua (2009) examined the relationship amongst stock markets and oil prices of GCC countries. By applying the linear and asymmetric cointegration method through the period weekly from January 1996 to December 2007, they found that there is response asymmetric in stock markets of Saudi Arabia, Oman, Bahrain, and Kuwait to oil price changes.

Furthermore, Hamadeh and Choi (2006) aim to identify the influence of US financial and oil markets along with the performance of stock markets of GCC countries, through the application of Vector-Error Correction (VEC) model over the period spanning over year 1994 to 2004, on the basis of weekly data. Long term equilibrium relationship is found to be existing via results of the cointegration tests. Markets of GC countries does not conceive short term direct predictability of S&P 500 index and the oil price whereas they do conceive the short-term influence of US T-Bills. Analysis of the response refers to the S&P 500 shocks have a positive impact on all GCC markets, and the T-bill rate has an influence important but mixed.

Aroura et al. (2011) examine GCC countries through the spectrum of relationship between stock markets shock and oil price shocks, along with examination of return links. By applying VAR –GARCH model of the daily data from 7 June 2005 to 21 February 2010. They found the existence of volatility spillovers and substantial returns amongst stock markets of GCC Countries and international oil prices. Oil's demand as well as supply is affected by political changes and shocks. As a result, Gulf stock markets are affected directly through the transmission of this effect through fluctuations in oil prices.

Azar and Basmajian (2013) attempt to examine the extent of influence, Saudi and Kuwaiti stock markets, take of shocks in the oil price. They collected daily data (Monday, Tuesday and Wednesday) from January 2008 to October 2012. By application of three types of non-linearity, that is Test Quadratic Functional Forms, Division of oil price shocks in 2 groups such as in negative and positive, and the use of GARCH (1,1) model for regression residuals. The study obtains important results are heterogeneity in responses between oil price and stock markets. While there is some evidence that oil price shocks affect positively and linearly on stock markets, but those evidence disappears with the addition of variables to the regression. It was found that, Kuwait's stock market did not conceive any linear or non-linear impacts of largely specified oil price shocks. On another hand, it is found that both oil price shocks and shocks in US S&P 500 cast non-linear impacts on the Saudi stock market. However, commonly, both Saudi and Kuwaiti market illustrates positivity with US S&P 500's shocks.

2.3 Saudi Case Studies

The impact of oil price fluctuations over Saudi stock market is important for investors, market participants and policy authorities that make decisions on regulation of the securities market and oil price policies. Also, it provides insight into the correlation amongst oil prices and stock markets which in turn very beneficial for the investors to revamp their portfolios and investment avenues. For example, join (2013)

researches the relationship amongst Saudi stock market and oil price through the application of VAR (1)-GARCH (1, 1) model using weekly data for the time from January 10th, 2007 up till September 28th, 2011. One of the findings illustrates that there exists a unidirectional impact between shock oil price and few sectors with regard to returns. However, there exist bidirectional impact with regard to patterns of fluctuation with more clear relationships, flowing from sectors to the shocks in oil prices. Moreover, it seems as if previous returns in the stock sectors does not require any support in order to forecast variation in oil price. With the paradigm of volatility, there do exist more spillover effects flowing from the stock markets to the oil price as well as there exists substantial spread between Saudi stock market and oil price. In addition, hedge and weigh proportions illustrate that risk adjusted performance can increase if oil is made part of varied stock portfolio.

Moreover, Khamis et al. (2018) focused on employment of daily data to carryout investigation on the Saudi stock market's response at a sectoral level towards fluctuations of oil prices. With the use of Granger Causality and regression investigates the dynamics of sectorial responses through the use of four years intervals from 2012 to 2015. The results of this study show that Saudi Arabia stock market depicts an asymmetric response to the oil prices and it illustrates negativity where all sectors interacts with the oil prices in negative manner in different capacities. Furthermore, oil prices influencing in the Saudi stock market with a statistical significance; cement sector is the only sector which is affected substantially with oil prices.

2.4 Distinguishing Features of this Study

In comparison to previous empirical studies in developed and developing countries, the GCC countries and Saudi Arabia, our paper provides a comprehensive analysis of the longstanding link amongst Saudi equity market and crude oil prices. Since the start of 1995 stock market registration to the end of 2018, by making employ of traditional linear Co-integration and the newly developed nonlinear ARDL method to asymmetric cointegration between shocks crude oil prices and Saudi Arabia stock market prices. It is also a point to ponder that instead of some literature's experimental studies which utilizes those processes for the long-run relationship, we employ it to explore the impacts of reverse reversion between the series. The utilize of those processes is beneficial in order to allow us to be preferable to understand the fluctuation of the oil price and stock market. Accordingly, we can structure an exact asset pricing process, better forecasting of returns and fluctuations in stock and oil markets and move towards better computation of oil risk against the value at risk. Due to shocks of oil price, Investors will consequently be able to better forecast volatility in proportion to their portfolio's value.

III. Methodology and Data

3.1 Type of the Study

This research focuses on verifying of a prolongassociation among stock markets in Saudi Arabia and shocks of crude oil prices.That is through a test for both traditional linear Co-integration and the nonlinear ARDL method to asymmetric cointegration between shocks crude oil prices and Saudi Arabia stock market prices (TASI index) and prove the existence of asymmetric Co-integration.

3.2 The Model

We must follow a two steps process: First, analyzing the time series to two parts positive and negative, by Shin et al. (2014). For clarification purposes, we use the logarithm of the stock markets series$\{\boldsymbol{LTASI}\}_{\boldsymbol{t}}^{\boldsymbol{T}} = \mathbf{0}$. Must be decomposed to their initial value and their cumulative negative and positive amounts:

$$\mathbf{LTASI}_{\boldsymbol{t}} = \mathbf{LTASI}_{\mathbf{0}} + \mathbf{LTASI}_{\boldsymbol{t}}^{+} + \mathbf{LTASI}_{\boldsymbol{t}}^{-} (1)$$

Where$\boldsymbol{LTASI}_{\mathbf{0}}$ is the initial value and?

$$\boldsymbol{LTASI}_{\boldsymbol{t}}^{+} = \sum_{i=0}^{t-1} 1\{\boldsymbol{\Delta LTASI}_{\boldsymbol{t-i}} \geq \mathbf{0}\}\boldsymbol{\Delta LTASI}_{\boldsymbol{T-I}}$$

and

$$\boldsymbol{LTASI}_{\boldsymbol{t}}^{-} = \sum_{i=0}^{t-1} 1\{\boldsymbol{\Delta LTASI}_{\boldsymbol{t-i}} < 0\}\boldsymbol{\Delta LTASI}_{\boldsymbol{T-I}} \quad (5)$$

1 {. }act as a pointer function with value one in the case when the brackets event happens and zero for its opposite case.

Second step: asymmetric Co-integration test amongSaudi stock market and crude oil prices by estimating the below long-lasting relations:

$$\mathbf{LTASI}_{\boldsymbol{t}} = \boldsymbol{\beta}_{\mathbf{0}}^{+} + \boldsymbol{\beta}_{\boldsymbol{T}}^{+}\boldsymbol{LOil}_{\boldsymbol{T}}^{+} + \boldsymbol{\beta}_{\boldsymbol{T}}^{-}\boldsymbol{LOil}_{\boldsymbol{T}}^{-} + \boldsymbol{\xi}_{\mathbf{1}\boldsymbol{t}} \quad (4)$$

Where$\mathbf{LTASI}_{t}^{+}$, $\mathbf{LTASI}_{t}^{-}$, $\mathbf{LOil}_{t}^{+}$and$\mathbf{LOil}_{t}^{-}$respectively are the positive and the negative constituent of stock market logarithms (TASI) and the crude oil prices as determined in above two equations.

$$\mathbf{LOil}_{\boldsymbol{t}} = \sum_{j-1}^{t} \boldsymbol{\Delta}\,\mathbf{LOil}_{\boldsymbol{j}}^{+} = \sum_{j-1}^{t} \boldsymbol{mas}(\,\boldsymbol{\Delta}\mathbf{LOil}_{\boldsymbol{j}}, \mathbf{0}) \qquad \boldsymbol{and} \quad \mathbf{LOil}_{\boldsymbol{t}} = \sum_{j-1}^{t} \boldsymbol{\Delta}\,\mathbf{LOil}_{\boldsymbol{j}}^{-} = \sum_{j-1}^{t} \boldsymbol{mas}(\,\boldsymbol{\Delta}\mathbf{LOil}_{\boldsymbol{j}}, \mathbf{0}) \quad (2)$$

When standard ECM is used for accounting the asymmetries in both dynamics i.e., long- and short-run, Shin et al. (2014) describes that equation (5)is expendedto get a cointegration model that is more general as

$$\boldsymbol{\Delta}\,\mathbf{LTASI}_{\boldsymbol{t}} = \boldsymbol{\rho\xi}_{\boldsymbol{t-1}} + \boldsymbol{\rho}_{\mathbf{loil}}\mathbf{LTASI}_{\mathbf{t-i}} + \boldsymbol{\rho}_{\mathbf{loil}}\mathbf{LOil}_{\mathbf{t-i}} + \sum_{\boldsymbol{j=1}}^{\boldsymbol{p-1}} \boldsymbol{\gamma}_{\boldsymbol{i}}\,\boldsymbol{\Delta}\,\mathbf{LTASI}_{\boldsymbol{t-i}} + \sum_{\boldsymbol{j=0}}^{\boldsymbol{q-1}} (\boldsymbol{\pi}_{\boldsymbol{j}}^{+\prime}\boldsymbol{\Delta}\,\boldsymbol{LOil}_{\boldsymbol{t-j}}^{+} + \boldsymbol{\pi}_{\boldsymbol{j}}^{-\prime}\boldsymbol{\Delta}\,\boldsymbol{LOil}_{\boldsymbol{t-j}}^{-}) + \boldsymbol{\xi}_{\mathbf{1}\boldsymbol{t}} \quad (3)$$

Where $\boldsymbol{\pi}_{\mathbf{0}}^{+} = \boldsymbol{\theta}_{\mathbf{0}}^{+} + \boldsymbol{\omega}, \boldsymbol{\pi}_{\mathbf{0}}^{-} = \boldsymbol{\theta}_{\mathbf{0}}^{-} + \boldsymbol{\omega}, \boldsymbol{\pi}_{\boldsymbol{j}}^{+} = \boldsymbol{\vartheta}_{\boldsymbol{j}}^{+} - \boldsymbol{\omega}'\boldsymbol{\Lambda}_{\boldsymbol{j}}\ \boldsymbol{and}\ \boldsymbol{\pi}_{\boldsymbol{j}}^{-} = \boldsymbol{\vartheta}_{\boldsymbol{j}}^{-} - \boldsymbol{\omega}'\boldsymbol{\Lambda}_{\boldsymbol{j}}$

for $\boldsymbol{j} = \mathbf{1}, \ldots, \boldsymbol{q} - \mathbf{1}$

Equation (5) allows us to test whether price variation of crude oil has asymmetric or symmetric effect on the stock market (TASI index).

3.3 Hypothesis Formulation

The descriptive approach in the research was adopted by linking the results to the reasons and interpretation of the data in light of the economic theory. Also, using the empirical method by measuring the

relationship between them based on measurement methods according to the criterion to discuss the hypothesis of research in which we seek to prove the hypothesis of the alternative from the null hypothesis.

Which means in the case H0: β2=0, where is explained the shocks crude oil prices do not affect Saudi stock market this means there is no effect between the variables.

Whereas the H1: β2≠0 that means the existence the shocks crude oil prices effects of positively or negatively on the Saudi stock market.

3.4 Data Sources and Sample Selection

In order to achieve the objective of research in the investigation of the effect on the Saudi stock market by crude oil price shocks,this study focuses on dynamic volatility systems between Saudi stock market (TASI index) and crude oil price shocks through the weekly duration starting at January 1995 to December 2018. The analysis of weekly data allows to link between shocks crude oil prices and stock prices better than monthly or daily data. However, as compared to daily analysis of data, the weekly analysis decreases any probable preference which might occur, and this includes the effect of the bid request and asynchronous trading days. Also, monthly data may contain some factors that affect asymmetry in relationto the changes of oil price on stock market (see Aroura et al. 2011). In addition, as mentioned in latest empirical study, more accurate results in terms of estimating and predicting many criteria comes by performing weekly data analysis(Aroura & Nguyen, 2010). We use the Saudi stock index TASI that is obtained from the World Bank and the OPEC crude oil price obtained from OPEC based on the US dollar.

3.5 Statistical Technique

The statistical technique is used in this research to assess the long-termassociation among Saudi stock markets and shocks crude oil price by applying traditional linear Co-integration and a non-linear ARDL model (NARDL) to asymmetric cointegration which was added to the EViews program at 2017.

Unit root test is a time series testing for stationarity. If the distribution shape is not affected by the time shift, then stationarity exists in time series. Co-integration tests investigate possible correlations among several time series in the long-run. Co-integration test analyses the range of the integration of these variables.The series is said to be co-integrated If a two series Y and X are both integrated, but there is some linear combination that is stationary, so the variables share a stochastic trend.Granger-causality is a way to investigate causality between two variables in a time series (see Hood et al. 2008).

The Non-linear ARDL model approach is a method ofpartial sum decomposition in terms of positive and negative, allowing detecting short and long-run asymmetric effects (Shin, Yu, and Greenwood-Nimmo 2014). Some of the advantages offered by NARDL models include: Firstly, it enables to determine small samples cointegration relationships (Romilly, Song, & Liu, 2001). Furthermore, it can be used irrespective of the regressors being constant at zero or the first difference i.e. I (0) or I (1). However, it cannot be applied if the regressors are at the second difference I (2). The Autoregressive Distributed Lag (NARDL) cointegration technique does not solidify an assumption of any kind where every independent variable being taken into account must go through a process of integration where the order remains the same. Some more advantages of this co-integration technique include allowing the inequivalent framework of Shin et al. (2013) to measure short- and long-term models that are asymmetrical in nature, while also analyzing hidden co-integration within the

same framework. For example, in the short run, the impact of the shock is positive in the price of oil is greater, while the impact of the negative shock is greater in the long run (or vice versa).

Stationary tests are usually used to evaluate the integration structure of stock market and crude oil price. The cost of stock market and crude oil price is first tested for accessibility by evaluating the unit roots in series logarithm. For this purpose, a total of three tests must be used i.e.Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test (1992), Phillips Peron (PP) test (1988) and Augmented Dickey-Fuller (ADF) test (1979); where the KPSS test is considered the most beneficial out of all of the three.

IV. Interpretation of Results

4.1 Descriptive Data Analysis

The variables used in the empirical study include:

TASI Index (TASI) a digital measure showing the change in the share value of all those companies which are traded on the stock market of Saudi Arabia and is considered the TASI thermometer for the measure of changes and movements the stock market, it reflects the performance of the national economy, especially the profits of joint stock companies. TASI is calculated by multiplying the index value of the previous day due to changes in the free float market capitalization in index constituents.

Crude Oil price (the OPEC crude Basket price) is basically a subjective average of petroleum products and blends and considered to be one of the main characteristics of crude oil prices that is manufactured by the member companies of OPEC. By controlling the production, it allows OPEC to regulate the crude oil price within lower and upper limit. Basically, in comparison to heavy and light products of crude oil, basket price of OPEC is always higher than the West Texas Intermediate Crude Oil and Brent Crude Oil.

Variables data is shown in detail in the Table 1. Where to accomplish stationarity invariance of TASI index and OPEC crude basket price and to accumulate non-realities, real value has been applied to the data sets(Organization of the Petroleum Exporting Countries 2019).

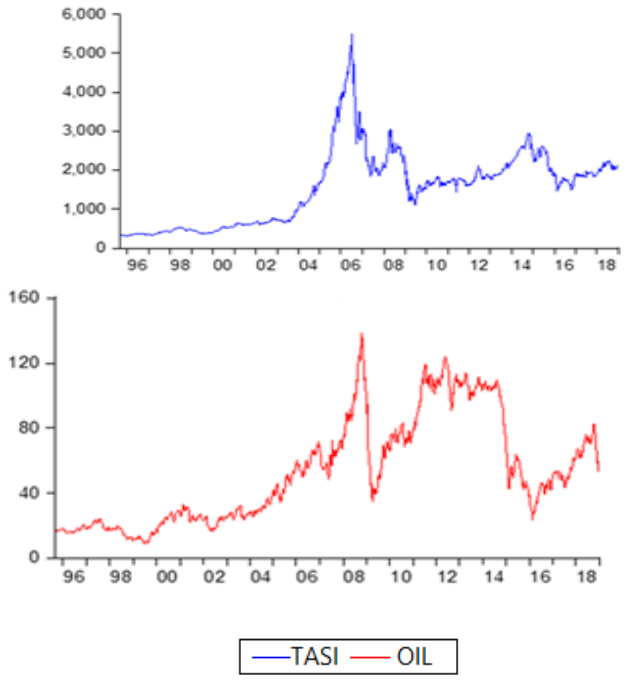
Table 1. Summary descriptive statistical data analysis

	TASI	**OIL**
Mean	1544.800	52.91539
Median	1683.460	47.39000
Maximum	5498.340	138.3100
Minimum	306.2800	9.440000
Std. Dev.	954.0102	32.59946

Skewness	0.740312	0.584791
Kurtosis	3.818771	2.132580
Jarque-Bera	145.5173	107.7839
Probability	0.000000	0.000000
Sum	1884656.	64556.78
Sum Sq. Dev.	1.11E+09	1295462.
Observations	1220	1220

The average weekly of TASI index is 15544.800 US and the maximum 5498.340 and minimum 306.2800 during the study period (Jan 1995- Dec 2018) with a high standard deviation implying a volatile stock market. In addition, the average weekly of crude oil prices is 52.91539 and 32.59946 standard deviation with maximum 138.310 and minimum 9.440 in the last 23 years.

Chart (1): Time Series Analysis TASI Index and OPEC Crude OilPrice



Source: EViews version 10

According to the time series analysis, in 1995, the number of stock companies was limited to about 67 companies, for that the value of the index was low. We observed that the value of the TASI index increases with

incrementing the number of companies contributing to it. In 2006 the TASI index reached its peak and on Feb 25, 2006, start the stock market collapsed sharply. In the mid of 2007 and at 2008's start, recovery was observed in the Saudi market, but the repercussions of the global crisis, which started in mid-2008, have weighed on international markets around the world, marking the lowest level in six years. On March 9, 2009, fully erased all gains realized during the market boom in 2003-2006. In 2014 the TASI index rose to its highest level after the global financial crisis. The TASI index continued to fluctuate in 2018.

On another hand, the time series analysis of OPEC crude oil price was fluctuating from 1995 to 2018. In 1998, the price of oil per barrel of oil in international markets fell from a level of $ 18 in 1997 to less than $ 10. Moreover, crude oil prices have been increasing since 1999. In 2008, the price of a barrel of oil reached the highest level of prices 138.31$. Then came to a sharp decline in crude oil price during the global crisis that began in the United States and then spread to the world to include European countries and Asian and developing countries whose economy is directly linked to the US economy. Thereafter the price of crude oil took to rise to 2015. In 2016, after the lifting of the US embargo on oil exports for 40 years, the crude oil price fell sharply to 39$. It was continued to fluctuate to 2018.

4.2 Unit root tests

Analysis's initial steps involves the testing of unit root's availability in lieu with crude oil price and the logarithmic summary of TASI index. Due to this, Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests (1992), Phillips Peron (PP) test (1988) and Augmented Dickey-Fuller (ADF) test (1979) will be applied for the analysis of time series.

Table 2: Unit root tests

	Levels			First difference		
	ADF	PP	KPSS	ADF	PP	KPSS
Oil	0.33 a	0.35 a	3.32***b	-28.5***a	-28.5***a	0.11 b
L TASI	1.47 a	-1.59 b	3.25***b	-33.1***a	-33.0***a	0.22 b

Notes: All variables are in natural logs. ADF is the Improved Dickey-Fuller test, PP the Phillips- Peron test and KPSS the Kwiatkowski Phillips-Schmidt-Shin test. (a) Model with no deterministic or constant trend, (b) model with constant and with no deterministic trend, (c) model with the constant and deterministic trend. Where *** denotes rejection of the null hypothesis respectively at 5%, 1%, and 10%.

In the situation where critical values of certain significance levels are larger than the statistic of the unit root tests, then there is no rejection of the unit root for ADF and PP or stationery for KPSS with respect to null hypothesis of the series. Table 2 presents outcomes of the tests of three-unit root. Most of these Unit root tests

confirms all variables to have order I (1) integration based on PP and ADF tests. While at the significance level of 1% all variables based on the KPSS levels are of order I (0) integration level.

4.3 Traditional cointegration tests

Analysis's second step involves transition amongst stock markets (TASI) series and crude oil price for standard cointegration tests. For the analysis we first applied Engle and Granger (1987) testing. It will then investigate the (6) through OLS and would then employ unit root hypothesis test for residuals:

$$LTASI_t = \beta_0 + \beta_1 LOil_t + \xi_t (6)$$

If,ξ_t , residual sequence is stationary then there exist cointegration. To cope up with this, the strategy we used in PP, ADF and unit root tests, will again be utilized. For the assertion of results, cointegration test using Johansen (1991) methodology will be applied. Johansen test's null hypothesis illustrates that there exist no cointegration relationship and its result is shown below in table 3.

Table 3: Traditional cointegration tests

	ADF	PP	Johansen
L TASI	-2.15	-2.11	8.11**

Notes: ADF (The Augmented Dickey-Fuller test), PP (The Phillips-Peron test) and Johansen the trace statistics. *, ** and *** denote rejection of the null hypothesis respectively at 10%, 5%, and 1%. We apply unit root tests on residual series ξ_t

As per the PP and ADF tests, outcome of the residual series explains that it is stationary. However, TASI index and Oil prices are not integrated because according to Johansen tests, cointegration hypothesis are not rejected.

We, according to traditional cointegration, note the non-appearance of long-term relationship amongst Stock market and crude oil prices in the Saudi Economy which depends largely on oil. Where some recent research has shown that there are clear evidences to support asymmetric relations amongst two variables because link amongst economy and shock crude oil prices is not linear [Hamilton (2003), Lardil and Mignon (2006, 2008) and Zhang (2008)]. Hence, one conclusion can state that neither asymmetric long-term relationships get multiply nor can co-integration tests be restricted. For the rest of the paper, a nonlinear Panel ARDL model (NARDL) to asymmetric cointegration, will be used.

4.4 Non-linear ARDL test

In the third step, we are using the Non-linear ARDL model developed by Shin et al. (2014). That is utilized so as to allow both negative and positive partial total decompositions for the detection of both short- and long-term asymmetric impacts. By applying of NARDL which is basically the derivative of basic linear Error

Correction Model (ECM) (Jamari et al. (2015)) based via Stepwise regression. In addition, deriving long-run coefficients. Table 4 provides the outcomes of NARDL ECM tests.

Table 4: Non-linear ARDL test

S/N	Variables	Coefficient	t-values	p-values
1	C	0.084894	1.536612	0.1255
2	LTASI (-1)	-0.014699	-1.563306	0.1191
3	LOIL_P(-1)	0.014591	3.329947	0.0010
4	LOIL_N(-1)	0.013905	3.202842	0.0015
5	DLOIL_P	0.192573	4.406417	0.0000
6	DLTASI(-1)	0.182249	3.208474	0.0015
		R-squared = 0.137	F-Test = 8.933 (p-value = 0.0000)	

The result presented in Table 4 shows the Non-linear ARDL output in which some of the lags that are not significant had been automatically removed by the EViews NARDL system. The long-run coefficient can be calculated from the coefficient of LOIL_P (-1) 0.014591 and LOIL_N (-1) 0.013905 by diving the negative of the two coefficients by the coefficient of LTASI (-1). The long-run coefficient of LOIL_P is 0.014591 / -0.014699 = 0.992652 and the long-run coefficient of LOIL_N is 0.013905 / -0.014699 = 0.945982. The long-run equation is therefore presented as:

LTASI = 0.992652LOIL_P + 0.945982LOIL_N

This, therefore, increases 1 per cent point in crude oil price leads to 0.99 per cent point increase in the Saudi Arabia stock market. Also, decrease 1 per cent point in crude oil price leads to a decrease in Saudi Arabia stock market 0.94 per cent point. This illustrates that in the longer run, positive relationship, in regard with Saudi stock market, exists amongst the negative and positive crude oil price shocks.

4.5 Asymmetric cointegration tests

In the fourth step, we are looking forward to assessing that can conclusion of traditional joint integration test be changed totally through negative and positive partiality of the time series decomposition. It can also be said as, does Saudi stock market and crude oil price shocks conceive existence of an asymmetric integrative relationship.

Cointegration test using Wald test-coefficient needs to be conducted to check if the variables are cointegrated before drawing any conclusion as regarding the estimated coefficient. Following the recommendation of Shin et al. (2011) and Psarian et al. (2001), regarding cointegration test under non-linear

ARDL. The joint null hypothesis of the level is used and compared to critical values of bond testing with the decision rule that co-integration will not exist if F-statistics is calculated to be greater as compared to the upper critical value. However, it will exist if calculation is contrary to this. Table 5 presents the results of cointegration tests.

Table 5: Asymmetry co-integration test

Test Statistic	Value	df	Probability
F-statistic	3.824153**	(3, 280)	0.0104
Chi-square	11.47246	3	0.0094

Notes: *, ** and *** denote significance at the level respectively at 10%, 5% and 1%.

The result shows that the F-Statistic is greater than the F-tabulated. In other words, the P-value is less than 5%, that is mean the value is significant, which means rejecting the null hypothesis of no presence of asymmetric cointegration amongst Saudi stock market and crude oil price.

4.6 Testing the presence of asymmetry

Finally, we estimate the long-run asymmetric relationships between crude oil price as well as the stock market in Saudi Arabia by using asymmetries testing in NARDL. TASI Index conceive positive impact of both positive change and the negative change in oil price, in longer run. To ascertain if coefficients are equal or not, we use the asymmetry test, and if there is the presence of asymmetry, then they are not equal, and if there is no evidence of asymmetry, then they are equal. Using a Wald test, we test the long-run coefficient of the variables that we derived in the non-linear ARDL result.

Table 6: Long term asymmetry associationamong oil prices and TASI index

Test Statistic	**Value**	**df**	**Probability**
t-statistic	0.726855	280	0.4679
F-statistic	0.528318	(1.280)	0.4679
Chi-square	0.528318	1	0.4673

Notes: *, ** and *** denote significance at the level respectively at 10%, 5%, and 1%.

The results display the p-value of the variables is greater than 5 per cent, and we will, therefore, accept the null hypothesis of no presence of the evidence of asymmetry amongst Saudi stock market and crude oil price. Result indicates of equality on the Saudi stock market, regarding effects of negative and positive change in crude oil price. This result is established by the result from the NARDL in which the long-run positive and negative coefficient is so close.

V. Summary and Conclusions

5.1 Conclusions

This research objective is to analyze the response of the Saudi Arabia stock market to the shocks of crude oil prices. To determine the asymmetric stock market response from the positive and negative changes in crude oil prices, the nonlinear ARDL model is implemented that is basically the Shin et al. (2014) model panel data exemplification suggested for time series.The study utilizes crude oil weekly price (the OPEC crude Basket price) obtained from OPEC and Saudi stock index TASI that obtained from the World Bank expressed in the US dollar, over the period weekly from January 1995 until December 2018.

To estimate the study models, the ADF test, PPP test and KPSS test are implemented to perform unit root tests where most of the variables were shown to be stable in the order I (1). However, the results of this research show that the shocks of crude oil price affect the Saudi Arabia stock market (index TASI) in the long-term in an asymmetric fashion. The traditional co-integration tests show that there is no correlation linear in the long or short-run between stock markets and shocks of crude oil price in the crude oil-dependent Saudi economy.

The Non-linear ARDL model illustrates a positive association among theSaudi Arabia stock market and positive and negative crude oil price shocks in a long-run. Where leads raise 1 per cent point in crude oil price to 0.99 per cent point increase in the Saudi Arabia stock market. On the other hand, reduction1 per cent point in crude oil price leads to a reduction in Saudi Arabia stock market 0.94 per cent point. In addition, demonstrate there is an asymmetric cointegrationbetween shocks crude oil price and the Saudi Arabia stock market.As well indicates that there is equality in the effect of both positive and negative variation in crude oil price on the stock market of Saudi Arabia (TASI index) asymmetric in the long-run.

So, our findings have to be attention to researchers, organizers, and market entrant. The Government of Saudi Arabia, as OPEC policy maker, need to examine the influences of crude oil price variations on its overall economy and its stock markets. Also, for investors, the degree of predictability in stock markets involves an important association among stock markets and crude oil prices.

The results of this research provide several ways for the researcher in the future: First, the relation among the Saudi Arabia stock market and crude oil price will change in the coming years as the government seeks to reduce its reliance on oil revenues with the vision of 2030. Second, the research methodology used here can be implemented to analyze the influence of other energy products. At last, additional causal research can be compared between the oil and stock market of Saudi Arabia and other exporting countries.

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